US005294810A

United States Patent [19]

Egusa et al.

[11] Patent Number: 5,294,810

[45] Date of Patent: Mar. 15, 1994

[54] ORGANIC ELECTROLUMINESCENT DEVICE

[75] Inventors: Syun Egusa; Nobuhiro Gemma, both of Yokohama, Japan

[73] Assignee: Kabushiki Kaisha Toshiba, Kawasaki, Japan

[21] Appl. No.: 921,379

[22] Filed: Jul. 30, 1992

Related U.S. Application Data

[63] Continuation of Ser. No. 501,251, Mar. 29, 1990, abandoned.

[30] **Foreign Application Priority Data**

Mar. 31, 1989	[JP]	Japan	1-83568
Sep. 29, 1989	[JP]	Japan	1-254960
Feb. 6, 1990	[JP]	Japan	2-25100
Feb. 6, 1990	[JP]	Japan	2-25101

[51] **Int. Cl.**[5] **H01L 29/28**; H01L 33/00

[52] **U.S. Cl.** **257/40**; 257/97; 257/103

[58] **Field of Search** 357/8, 17; 257/40, 96, 257/97, 103

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,757,364	7/1988	Miura et al.	357/17
5,093,698	3/1992	Egusa	257/40

FOREIGN PATENT DOCUMENTS

120673	10/1984	European Pat. Off. .
61-44974	3/1986	Japan .

OTHER PUBLICATIONS

Sze, Physics of Semiconductor Devices, 2nd Ed (Wiley, New York, 1981), pp. 708–710.

Applied Physics Letters, vol. 51, Sep. 1987, pp. 913–915, New York, US; C. W. Tang et al.: "Organic electroluminescent diodes".

Japanese Journal of Applied Physics, vol. 27, Feb. 1988, pp. L269–L271; C. Adachi et al.: "Electroluminescence in organic films with three-layer structure".

Applied Physics Letters, vol. 56, Feb. 1990, pp. 799–801, New York, US; C. Adachi et al.: "Blue light-emitting organic electroluminescent devices".

Journal of Applied Physics, vol. 51, Aug, 1980, pp. 4555–4557, New York, US; T. Doi et al.: "Bright dc electroluminescence in ZnSe-ZnS:Mn thin films".

Appl. Phys. Lett., vol. 51, p. 913; C. W. Tang and S. A. Vanslyke; Sep. 21, 1987.

Jap. J. Appl. Phys., vol. 27, L269; C. Adachi, S. Tokito, T. Tsutsui; and S. Saito; Feb. 1988.

Primary Examiner—William D. Larkins

Attorney, Agent, or Firm—Oblon, Spivak, McClelland, Maier & Neustadt

[57] **ABSTRACT**

In an organic electroluminescent device including first and second electrodes opposite to each other and a multi-layered body which is sandwiched between these electrodes and consists of a plurality of organic films including a light-emitting layer, a material for each organic film and electrode is selected so that electrons and holes are simultaneously and respectively injected from the first and second electrodes in the multi-layered body when a forward biasing voltage is applied, a large amount of injected electrons and holes are accumulated at the multi-layered body, and these electrons and holes are subjected to radiative recombination at a predetermined threshold voltage.

7 Claims, 20 Drawing Sheets